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(54) Vehicle restraint system cushion with sacrificial tear seam

(57) Inflatable air bag cushion (12) for use in a vehicle passenger restraint system includes circular front and back fabric panels (14, 16) joined at their edges by two circular rows of stitching constituting a main seam (18). A sacrificial seam (26) comprising a circular row of stitching of a weaker thread than that used for the main seam (18) is located between 3 and 10 centimetres from the main seam. When deployed, the sacrificial seam (26) ruptures and delays the point at which the main seam (18) is subjected to maximum pressure. The maximum tearing force exerted on the main seam is thereby reduced, reducing the tendency of the cushion fabric to fail. A method of manufacturing the cushion is described in which the panels (14, 16) are stitched together inside out. The cushion is then inverted prior to packing.

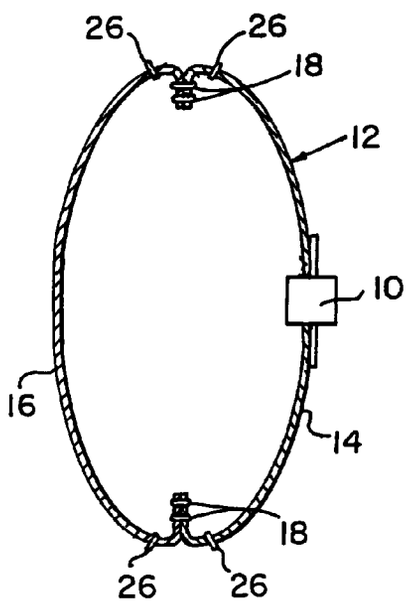

FIG. 1

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Description

This invention relates to vehicle restraint systems having air bag cushions, and more particularly to a cushion construction that has improved resistance to combing of the fabric at a seam between two panels.

Air bags are frequently made of at least two panels of a woven fabric that are joined at an outer marginal edge by a stitched seam using threads that have sufficient strength to withstand the maximum pressure that follows when the gas generator is actuated such as at the time of a vehicle collision. More specifically, current cushions use peripheral seam designs which are expected to survive the deployment of the air bag. These seams tend to result in "combing" where cushion fabric begins tearing adjacent to stitches when the cushion fabric is marginal for the inflator performance being used.

It is an object of the invention to provide a novel air bag cushion and method of construction and use which will reduce the load applied to or experienced at the peripheral outer main seam of a driver or passenger side air bag cushion.

The air bag cushion according to the invention includes a sacrificial seam located between the inflation gas inlet opening and the peripheral outer main seam that secures together two fabric panels which are used to form the air bag cushion. Upon inflation of the air bag which occurs during cushion deployment, the sacrificial seam, being located closely to the main seam, tears just before the maximum inflation gas pressure reaches the main seam without significantly changing the deployment pattern of the folded bag or destroying the integrity of the air bag as would occur if the main seam failed.

In a preferred embodiment the outer main seam may be formed while the bag is turned inside out, by one or more, usually two, rows of stitches of a thread sufficiently strong so as not to break. A sacrificial seam may be also added as a matter of convenience while the bag remains inside out. The sacrificial seam may be made of a continuous row of stitches positioned adjacent the main seam and of a thread having a lower strength that will fail at a predetermined load that will be exceeded by the inflator being used, just prior to full bag inflation. This arrangement will reduce the final load that the outer main stitched seam and adjacent fabric would experience, thereby preventing, or at least reducing, combing which would otherwise occur. Using this concept allows lower strength fabrics to be used which reduces overall cost of the cushion.

These and other objects and advantages of the invention will become more fully apparent from the claims and from a perusal of the following description in connection with the appended drawings.

Fig. 1 is a schematic elevation in section of an air bag cushion of an embodiment of an air bag restraint system in accordance with the present invention;

Fig. 2 is a plan view of a conventional air bag cushion shown inside out with two rows of stitches as is commonly used; and

Fig. 3 is a view similar to Fig. 2 but showing the new tear seam according to the invention.

The air bag restraint system diagrammatically shown in Fig. 1 includes a gas generator 10 arranged to generate high pressure gas to be supplied to the air bag cushion 12 in the event of a vehicle collision or the like. The air bag system for the driver side is typically formed of a back panel 14 that is attached to the steering column in a manner well known to those skilled in this art. Back panel 14 and front panel 16 may both have circular outer peripheries or marginal edges that are secured together by a main seam 18. As shown in Fig. 2, seam 18 may be formed by one or more, usually two, rows of stitches 20, 22 around the peripheral edge of the fabric of the two panels while the panels are turned inside out as is conventional. Before use, the bag preferably is turned right side out prior to folding. Frequently, an opening is provided in the middle of the rear panel and fitted to the opening of the gas generator 10 either in the steering column as in U.S. Patent No. 5,280,954 to Henesler et al. or on the dash board in front of the passenger seat.

Current cushions that use stitched seams are expected to survive the deployment of the air bag. These seams tend to result in combing where the cushion fabric begins tearing adjacent to seam stitches when the cushion fabric strength is marginal for the inflator performance being used. According to this invention, such combing may be prevented, or at least reduced, to an acceptable level, by adding a sacrificial seam 26 as illustrated in Fig. 3. The purpose of the sacrificial seam is to tear upon cushion deployment. Seam 26 is purposely designed to have a lower strength than the main seam 18 so that it will fail at a predetermined load that may be between about 75% and 95% of the maximum load. The outer main seam 18 then survives throughout the entire cushion deployment.

While the sacrificial seam 26 may be formed as by bonded or welded seams, it is preferred to use a seam with stitches of a thread having a lower strength than that of the thread in stitches 20, 22 which form the main seam. Also it is efficient to sew the sacrificial seam 26 when the air bag is turned inside out. With a circular outer main seam, the sacrificial seam 26 may be made concentric as illustrated in Fig. 3. In the event the outer main seam follows a different path as is frequently the case with passenger side installations, the sacrificial seam 26 should be generally parallel so that the spacing is substantially uniform.

The spacing distance 30 between sacrificial seam 26 and the main seam 20 may vary. The inflator performance and the strength of the fabric influence the determination of an optimum distance 30. After the sacrificial seam 26 fails, an incremental increase in bag volume is provided without affecting the direction of normal bag deployment. As the explosive charge creating the gas

pressure for deployment is short lived, and as the air bag exhausts very rapidly after being filled, there is a time delay created before the final maximum load reaches the outer main seam 18 because of the tearing of the sacrificial seam 26. This deployment process results in an incremental increase in the cushion volume thereby causing a reduction of the maximum final load that the outer main stitches and adjacent fabric will experience. A representative spacing distance 30 of between about 3 to 10 centimeters or somewhat greater has been found to be appropriate for some applications. It is not intended that the orientation or direction of deployment be altered by reason of the sacrificial seam which is closely spaced and generally parallel to the outer main seam.

Claims

1. An inflatable impact protection air bag cushion (12) having front and back fabric panels (14, 16) joined adjacent marginal edges by a main seam (18) of thread stitches and a sacrificial seam (26) formed to be substantially coextensive with the main seam (18) and having a strength which causes said sacrificial seam to tear during inflation just prior to the time when inflation gas pressure exerts a tearing force on the main seam (18).

2. The cushion of claim 1 wherein the main and sacrificial seams (18, 26) are formed while the bag is inside out so that upon inflation the right way out the main seam (18) is initially located inside the cushion.

3. The cushion of claim 1 or 2 wherein the cushion fabric at least partially fails at the main seam (18) during normal inflation deployment.

4. The cushion of claim 3 wherein the stitches of the main seam (18) are of thread having a sufficiently high strength that said failure is constituted by cushion fabric combing or pulling apart at said stitches.

5. The cushion of any preceding claim wherein said sacrificial seam (26) is located between said main seam (18) and a gas inlet opening of the cushion so as to be subjected to the maximum inflation pressure before said pressure reaches said main seam (18), said sacrificial seam (26) being spaced generally parallel with the main seam and at a distance from said main seam that is sufficiently small so as not to substantially influence deployment while reducing the final load the main seam and adjacent fabric experience.

6. The cushion of any preceding claim wherein the main seam (18) is formed of thread stitches which are sufficiently strong so as not to break during normal deployment, and the sacrificial seam (26) is concentric with said main seam and formed of thread stitches which will break at a predetermined load that is between 75% and 95% of the maximum load or pressure experienced by the cushion to cause the sacrificial seam to tear during deployment.

7. The cushion of any preceding claim wherein the main and sacrificial seams (18, 26) are spaced apart by between 3 and 10 centimetres for creating a delay before maximum deployment pressure reaches the main seam (18).

8. The cushion of any preceding claim wherein the sacrificial seam (26) is sized and positioned to add an incremental volume to the air bag cushion that is effective to prevent failure at said main seam (18) and provide a slight delay before full inflation pressure reaches the main seam.

9. The cushion of any preceding claim wherein the strength of the sacrificial seam (26) is such as to delay when the maximum force due to inflation pressure reaches the main seam (18) so that the maximum force on the main seam is reduced.

10. A method of making an inflatable impact protection air bag cushion (12) comprising:

providing front and back panels (14, 16) of cushion fabric having peripheral mating edges;

joining the panel edges together *via* a main seam (18) which surrounds at least a portion of the air bag, said seam being formed of thread stitches;

forming a sacrificial seam (26) that is weaker than the main seam so that said sacrificial seam will fail at a predetermined pressure less than full deployment pressure, said sacrificial seam being closely positioned inside said main seam and of a sufficient strength to delay the time when the full deployment pressure reaches the main seam whereby the final load experienced by the main seam and adjacent fabric is reduced, without otherwise influencing directional deployment of the air bag cushion.

11. The method of claim 10 wherein the stitches of the main seam (18) have a strength such that with full deployment gas pressure, the main seam tends to result in combing where the cushion fabric begins tearing adjacent to seam stitches and the presence of the sacrificial seam reduces this tendency.

12. The method of claim 10 or 11 wherein the panels (14, 16) have circular outer edges that are joined together by a circular main seam (18) and including the step of forming the sacrificial seam (26) to be circular and concentric with the main seam with stitches of a thread that is weaker than the thread used for the main seam.

13. The method of claim 10, 11 or 12 wherein both the main seam (18) and the sacrificial seam (26) are

formed of stitches that are sewn while the bag is turned inside out and when deployed in a right side out condition, the sacrificial seam (26) is at the outer marginal edge of the air bag cushion.

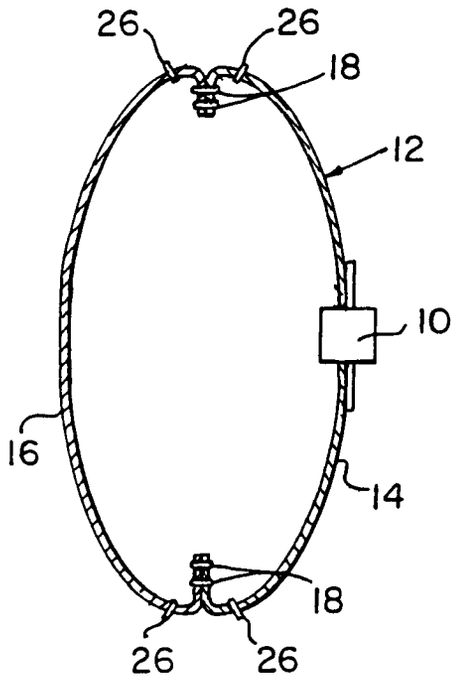
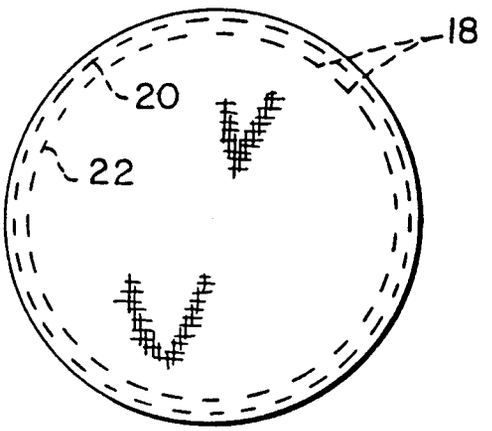


FIG. 1

FIG. 2
PRIOR ART



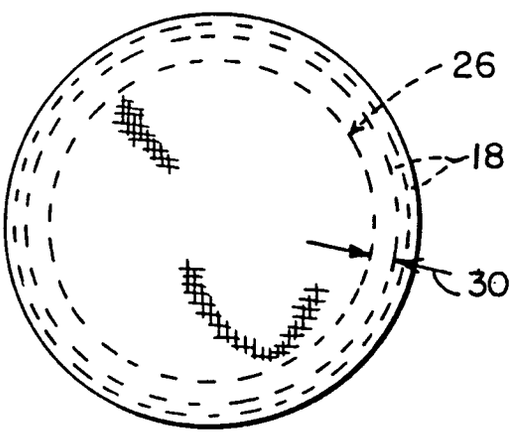


FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 9115

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 15 no. 225 (M-1122) ,10 June 1991 & JP-A-03 067748 (TOYODA GOSEI CO LTD) 22 March 1991,	1,2,8,9	B60R21/16
A	* abstract *	3,5-7, 10-13	

X	GB-A-2 257 950 (MERCEDES-BENZ AG) * figures 1,2,4 * * abstract *	1,10,12	
A	* page 8, line 2 - page 9, line 19 *	2,5-9,13	

A	PATENT ABSTRACTS OF JAPAN vol. 16 no. 467 (M-1317) ,29 September 1992 & JP-A-04 166454 (IKEDA BUSSAN CO LTD) 12 June 1992, * abstract *	1,10	

A	PATENT ABSTRACTS OF JAPAN vol. 16 no. 467 (M-1317) ,29 September 1992 & JP-A-04 166453 (IKEDA BUSSAN CO LTD) 12 June 1992, * abstract *	1,10	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B60R

A	PATENT ABSTRACTS OF JAPAN vol. 16 no. 405 (M-1301) ,26 August 1992 & JP-A-04 135941 (IKEDA BUSSAN CO LTD) 11 May 1992, * abstract *	1,10	

A	GB-A-2 257 952 (AIRBAGS INTERNATIONAL LIMITED) * figures 1-6 * * abstract * * page 4, line 15 - page 5, line 20 *	1,10	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 March 1996	D'sylva, C

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 9115

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 553 542 (GENERAL ENGINEERING (NETHERLANDS) B.V.) * figures 5,8 * * abstract * -----	1,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

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